THE WEST-GERMAN ANTARCTIC RESEARCH AND SUPPLY VESSEL

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For the Federal Minister of Research and Technology, the Antarctic Research and Supply Vessel of the German Federal Republic is presently under construction in a joint venture by Howaldtswerke-Deutsche Werft, Kiel/Werft Nobiskrug, Rendsburg. At this stage, the first sections are in production at the HDW shipyard in Kiel, in January 1982 the ship's hull shall be floated out of the building dock and be towed to Rendsburg for its outfitting. Trials of the vessel are planned for Autumn, 1982.

With this newbuilding, the Government of the German Federal Republic performs an essential part of its commitments undertaken when becoming a member of the International Antarctic Convention. Both, the vessel as well as the German Antarctic station, set-up in the beginning of 1981, will be operated by the Bremerhaven based Alfred Wegener Institut für Polarforschung. With these activities, the German Federal Republic underlines its serious interest in the scientific exploration of the Antarctic continent. I. a., one of the main assignments of the vessel will be the continuation and completion of the investigations of various scientific disciplines - carried out during the last years' expeditions of the vessels "Walter Herwig", "Meteor", "Polarsirkel", "Explora", "Weser" and "Julius Fock" - on a floating research station specially prepared for the aggravated environmental condititons. Furthermore the vessel shall be able to transport relief staff as well as supplies and materials to the Antarctic station. In the area of the Northern section of the Arctic Ocean, the oceanographic, meteorological and geophysical investigations of German research institutes shall be continued - partly in international cooperation.

Designing of the vessel was carried out in close contact with the scientific commission of the SCAR-Committee of the German Society for the Advancement of Scientific Research (Deutsche Forschungsgemeinschaft) under the leadership of Prof. Dr. O.

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Krappinger of the Hamburgische Schiffbau-Versuchsanstalt (HSVA), whose experience in icebreaking technology was included in the project. The general planning and scientific coordination is carried out in cooperation with the Hamburg consultants SCHIFFKO GMBH and for the general supervision of construction with the assistance of Zentralstelle für Schiffs- und Maschinentechnik der Wasser- und Schiffahrtsverwaltung des Bundes (ZSM). With regard to the mechanical conception of the vessel, AG Weser contributed their experts' knowledge during the preliminary design phase.

Design Philosophy

The design and planning of such a particular vessel with a large variety of new, very ambitious assignments, results in a big number of ships technical development tasks with effects into the last detail-construction and demands extremely high qualifications of the building yard. For example, the complete portable equipment of the vessel must be operational at the expected very low temperatures of up to -30° C, and for the vessel itself - in case of being trapped in ice during the winter season - it is imperative to be manoeuvrable at temperatures of up to below -50°C. This is an essential factor in the selection of materials, insulation- and heating systems for the accommodation and scientific quarters as well as for the ship's holds and the unprotected equipment and gaskets. Also, an Antarctic Research Vessel does not fit into the traditional pattern of regulations for ships' safety. Partly, its specific assignments make exceptions from the existing regulations necessary, on the other hand, increased requirements as to ship's safety and reliability become imperative due to the distant area of operation, where probably no help from outside will be available. Finally, a compromise must be found between the distinct requirements of the different scientific disciplines, which partly appear to be incompatible. In the present case, this problem was solved by the application of multi-purpose laboratories - mainly in form of containers for laboratories and equipment - and by fitting a special lashing system of high flexibility for equipment and containers in the working area.

Due to this fact, the technically highly developed vessel can be adopted to the different requirements of the individual scientific disciplines during different expeditions. The arrangement of winches, leading of wires and observation conditions for the winch operators in the winch control rooms have been investigated by means of a working model.

Equipment for scientific investigations

The following list of scientific disciplines which will operate aboard the vessel, demonstrates the large variety of functions to be fulfilled by the Antarctic Research and Supply Vessel:

- oceanography
- meteorology
- ocean biology
- ocean geophysics
- geology
- ocean chemistry
- air chemistry
- glaciology
- fishing research
- communication engineering
- naval architecture of icebreaking vessels

As stated in connection with the working area, special attention was paid to permit for speedy readjustment of the vessel from the demands of one scientific discipline to the following. In general, the hold II of the first deck is planned for preparational work, from where the equipment etc. will be transported to the working area by fork lift units or overhead crane. There two telescope beams are available which - assisted by a 15 t telescope lifting crane on boat deck - can be used to lower down scientific equipment in up to 3 m distance from the hull. The front telescope beam with a capacity of 5 t will be used for equipment of less weight, such as water samplers, and the aft telescope beam with a capacity of 20 t will be used for heavy equipment, which, for instance,

Additional equipment can be fitted on the telescope beam, for instance to carry coring equipment for cores of up to 18 m length. As the application of certain equipment, such as water samplers, is expected even at temperatures below Zero, part of the working area can be heated.

As a special feature, the vessel is equipped with two deep sea wires of 18 mm diameter and 12000 m length, offering the constant availability of one wire at the ship's side as well as one at the ship's stern simultaneously. All scientific winches and the telescope beams can be operated from the central winch control room. The vessel itself also - by means of a joy-stick device - can be operated directly from the central winch control room, in order to keep her in the required position with an exact field of vision to the working position of the research equipment.

The working deck is covered with wood and a system of bushing and container corner fittings. So small winches, laboratory and equipment containers can be temporary fitted in this foundation system.

For work over the stern a stern chute of 4 m beam and a gantry of 12 m height - movable into various working positions between 0° astern and 120° afore and fitted for 30 t load - are installed. For fishing the same friction winch as used for the deep sea wires will be used with 32 mm fishing wires. The fishing work is assisted by two multipurpose winches of 10 t each which can also be fitted with other drums for oceanographic research. The complete fishing equipment can be dismantled to get an unobstructed working space when fishery research is not on the programme.

For geophysical work a containerized streamer winch will be fitted astern as well as an air gun array, supplied with compressed air by 6 Junkers high pressure compressors (150 bar).

For special seismic work explosion charges can be carried in an ammunition chamber. For magnetometrical investigations a removable winch will be fitted on the working deck. Special foundations are also prepared in the 2nd deck to install a gravimeter, undisturbed by the ship's vibrations.

For their investigations, the meteorologist will have a complete meteorological station as well as a balloon filling station at their disposal on the helicopter deck. To fill theweather balloons, the ship's special hydrogen production plant can be used.

A non-contaminated laboratory will be available for the air-chemistry below the forecastle. By spars on the forecastle or from the 10 t crane or from a platform in the signal mast, air samples can be taken from areas which are not disturbed by the ship.

In the exploration of the Antarctic and also for navigation in the Arctic Ocean, special attention is paid to ecological considerations. For this reason, the Antarctic Research Vessel will be equipped with a waste incinerator and waste water cleaning system. In order to secure that samples of water etc. may be taken free of contamination of the vessel itself, the starboard side of the vessel will be comple-ly free of any spouts. All spouts of the cooling or other water systems will be fitted to port side.

For a limited period of time, the cooling system of the engines can be operated via an internal circulation. During such periods, abso-lutely no residues will leave the vessel. Chemical investigations with even higher demands as to absolutely uneffected environmental conditions from the research vessel itself can be carried out in the research launch of 12,5 m length, which is equipped for expeditions of several days and meets the specific requirements of the biolo-gical scientists.

For the glaciology the vessel will be provided with three pockets in the hull fitted with ice-pressure measuring equipment and various observation windows near the propellers.

Furthermore the thickness of the ice can be measured by impulse radar to be fitted on a spar over the bow.

Navigation and communication engineering

Of course, an Antarctic Research Vessel will be equipped with a highly sophisticated navigation and communication system as well as with a completely independent meteorological station. This will be carried out too. Just to mention a few, the following special features of the vessel may be underlined:

- Joy-Stick manoeuvring system with computerized control of c.p. propellers, fore and aft 15 t thruster and rudder to ensure optimum maneouvring capability

- Integrated Navigation System, using information from satellite and radio navigation as well as doppler speedometer

- Marisat-Satellite Communication System, which, with the assistance of the Federal Minister of Research and Technology was already used on the research vessel "Meteor" an in the "Georg von Neumayer"-Antarctic-station with excellent results.

- Apart from the fishing sonars and a narrow beam sounder, the vessel will be equipped with a seabeam bathymetric survey system , which allows to take measurements of depths of a broad sector of the seabed in one operation with the corresponding display on a bottom profile chart. Hitherto depths measuring systems only allowed measurements of a very narrow line of the seabed, making necessary a considerable number of operations for the survey of a certain area.

At many places of a research vessel, the constant supply of information about the exact position of the vessel, speed, water depth, salt content, meteorological situation etc. are required. For this purpose, a data distribution system, connected to the integrated navigation plant is fitted with a display of the required information

in so-called intelligent monitors, permitting the scientists to read the indicated values from the display and to transfer the indications to their own recorders. Also the data measured on the winches are shown on screens of a winch data measuring system. To transfer measured data between the laboratories or from locations outside, a measured data distribution system will be fitted which also can be used for transfer of any other information. Further cable trays are prepared for the fitting of "flying cables".

Icebreaking

Compared to other traditional icebreakers, this vessel has a larger midship section. This form was developed by the HSVA, based on a series of intensive model tests in their special ice testing laboratory. With full power, the vessel is able to breack ice of 1 m thickness with a speed of 5,5 knots. By ramming with a speed of 7 knots the vessel will penetrate ice ridges of 2 m thickness up to half ship's length. In order to provide for the required strength when ramming the ice and taking into consideration the pressure of ice in case of being trapped for the winter season, the ship's hull will be reinforced for an ice pressure of 9,5 N/mm² in the fore part and 6 N/mm² a the sides. The strength complies with the Canadian Ice Class Arc 7; the machinery will be provided for Ice Class Arc, 3.

With the installed propulsion power of totally 14680 kW (20000 PS), the expected good ice breaking qualifications of the vessel, which are considerably improved by the installation of the Jastram-air bubble system, the ship will enable the German Antarctic expeditions in all probability to guarantee - even under unfavourable ice conditions - the desired operational performances.

Helicopters

Helicopters will serve to assist navigation in ice areas, but also for unloading of supplies and materials and the transport of passengers. Additionally they will be required for a variety of scientific performances. For this purpose, a hangar and the respective landing deck have been provided for in the vessel. All technical provisions to enlarge the landing deck by fitting additional sections have been made, in case it should be necessary to make use of larger types of helicopters in the future.

Supplies/Materials for the Antarctic Station

With destination of the Antarctic station, the vessel will be able to carry up to 1600 t of supplies and materials, from which the largest part are fuels which partly can be stored in the ship's bunkers and partly in containers or drums. For the purpose of higher flexibility, it was originally intended to use the same fuel for the powerstation and vehicles based on the Antarctic station and the vessel itself. The immensely increased costs of fuel, however, made a change of this plan inevitable. For the station itself, supplies of high grade "Arctic Diesel" are still necessary, but the vessel will now be operated with heavy fuel (IF30), which can be stored in heated bunkers.

In order to store a maximum of supplies and materials in containers, special container corner fittings are provided, not only in the holds but also on top of the hatches and the working deck aft.

It may be useful to direct the vessel with the bow to the ice edge for unloading operations at the Antarctic research station. This may be necessary due to strong swell and the danger of breaking down of pieces of the ice edge. Therefore the bow of the vessel has been strenghthened accordingly and a 10 t crane of large extension will be fitted on the forecastle.

Heavy tractors and other heavy materials can be handled by a 25 t crane which can reach up to about 25 m above the water level.

The design of the vessel is based on the experiences of three expeditions into the Antarctic. They showed that the environmental conditions - ice conditions, waves, tides, height and fragility of the ice and the existing shelf ice edge - are subject to considerable changes. For instance, in 1978/79 it was not possible to penetrate with a 7500 PS icebreaker into the area of the Weddell-Sea as it was intended. During the expedition of 1979/80, this area was nearly free of ice, and in 1980/81 the expedition met so much ice that the station had to be erected in another operational position as originally intended.

All those involved in the design, planning and construction of the German Antarctic Research and Supply Vessel, i.e. the yards, subcontractors and even more so all those responsible for the planning and supervision of the project have tried to cope with the described imponderabilities as far as possible, and to all of them it was a challenge that demanded a much higher degree of work load and ingenuity than the construction of a traditional standard vessel does, but at the same time - and in spite of many difficulties - they regarded and regard it as a rewarding and fascinating experience.

SHIPS DATA SHEET

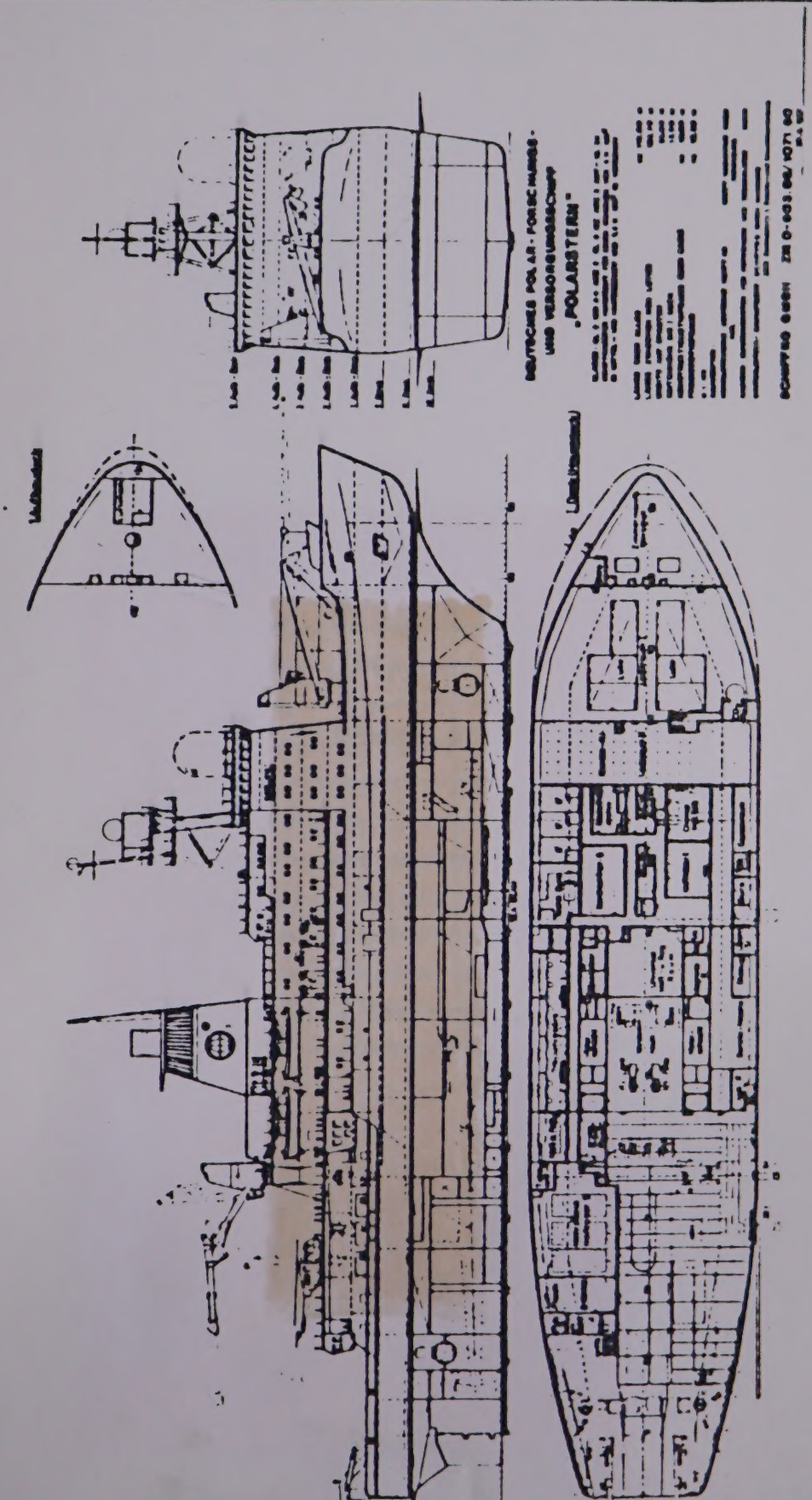
Main Dimensions:

Length o.a.	approx.	118,00	m
Length between perpendiculars		102,20	m
Beam moulded	max.	25,00	m
Depth to main deck		13,60	m
Draught	max.	10,50	m
Deadweight	approx.	3900	t/metric
Speed on trials	approx.	15,5	kn
Engine power		4 x 3670 kW (5000 hp)	
Total complement		106	persons
consisting of:			
- crew		36	persons
- scientific personnel		40	persons
- relief staff for polarstation		30	persons

Class: Germanischer Lloyd ⊞ 100 A 4 Arc 3
+ MC Arc. 3 Aut 16/24
Hull strengthened for an icre pressure of 6 N/mm² in midbody and stern and 9 N/mm² in the fore part.

Machinery:

- four reversable medium speed diesel engines burning heavy fuel (IF 30) each of 3670 kW (5000 hp) (Deutz)
- two double-reduction gears with one p.t.o. each for shaft generators and fitted with clutches (Renk)
- two variable pitch propellers, four-bladed, made of C_rNi steel and running in nozzles, propeller speed 180 r.p.m. (Escher Wyss)
- one bow thruster and one stern thruster 150 kN each (KaMeWa)
- two diesel generators each of 1290 kW/1500 kVA and 750 r.p.m. (MaK)
- two shaft generators each of 2700 kVA (1100 to 1400 r.p.m.) (AEG)
- one emergency diesel generator 560 kVA, 1500 r.p.m. (Janssen)
- fin stabilizer system (HDW-AEG)
- heeling and anti-rolling tanks (Intering)



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